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Does Nurse Management Effect Continuous Renal Replacement Downtime?

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DOES NURSE MANAGEMENT EFFECT CONTINUOUS RENAL REPLACEMENT THERAPY DOWNTIME? A RETROSPECTIVE CHART REVIEW.

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Abstract

Acute kidney failure (AKI) is common among patients in the intensive care unit (ICU) and can have a mortality rate of up to 70%. Continuous renal replacement therapy (CRRT) provides constant dialysis treatment and is the recommended treatment for hemodynamically unstable AKI patients. Delay in CRRT delivery and interruptions of therapy are associated with negative outcomes such as fluid overload, electrolyte imbalance, acid-base imbalance and death. To reduce CRRT downtime, there has been a trend for the critical care nurse to be autonomous with the set-up, management and trouble-shooting of treatment instead of a collaboration between the critical care nurse and dialysis nurse. The purpose of this study was to investigate the difference in CRRT therapy downtime with critical care nurse management compared to collaborative management performed by the critical care nurse and dialysis nurse. This research was guided by Benner's Novice to Expert Model as it best represents the trajectory for nurses attaining the clinical competence to master total management of CRRT. A retrospective chart review was conducted with a total of 43 downtime incidences managed autonomously by the critical care nurse and a total of 48 CRRT downtime incidences managed by a collaboration between the critical care nurse and dialysis nurse. Results demonstrated that the mean CRRT downtime managed autonomously by the critical care nurse, 7,728.8 seconds was significantly less than the CRRT downtime managed by a collaboration between the critical care nurse and dialysis nurse, 13,915 seconds ($p = 0.01$). Further research is indicated to determine the best nursing management of CRRT to reduce treatment downtime.

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Background/Statement of the Problem

Acute kidney injury (AKI) is common among patients in the intensive care unit (ICU) and can have a mortality rate of up to 70% (James & Tonelli, 2011). Continuous renal replacement therapy (CRRT) provides constant dialysis treatment over a 24-hour period and removes small amounts of fluid hourly and clears waste from the body (Roeder, Atkins, Ryan & Harms, 2013). Fluid removal is assessed and adjusted hourly and accomplished via ultrafiltration of the blood (Dirkes & Hodge, 2007). Continuous renal replacement therapy allows for less fluctuation in fluid balance and is especially beneficial for patients who have hemodynamic instability (Schell-Chaple, 2017).

Timely initiation of CRRT may impact survival outcomes of patients with AKI (Karvellas et al., 2011). Once central venous access of a dialysis catheter has been placed, rapid and efficient set-up of the CRRT dialysis machine and therapy connection to the patient by nursing is necessary to begin treatment (Baldwin & Fealy, 2009). It is important to minimize interruptions during CRRT treatment for the patient to get the full benefit of the dialysis therapy. These interruptions are referred to as therapy "downtime" which is defined as any unplanned interruption of CRRT therapy in which a patient is not receiving dialysis. In addition to routine change of the circuit filter, the nurse must manage interruptions in treatment such as clotting of the dialysis filter, central venous dialysis catheter access problems and rising filter pressures (Roeder et al., 2013).

Minimal research has looked at nursing management of CRRT and the impact it has on timely initiation of therapy, minimizing interruption of treatment, patient outcome and the provision of cost-effective care (Golestaneh, Richter, & Amato-Hayes, 2012).

Instituting a CRRT nurse education program is usually an individual hospital-based design as there are no universal protocols or competencies to guide nursing management (Golestaneh et al., 2012). There are two main nursing models of CRRT management that are used by intensive care units: (1) total management by the critical care nurse to include set-up and advanced troubleshooting: and (2) the dialysis nurse is responsible for machine set-up and advanced trouble shooting, and the critical care nurse does the hourly management of fluid removal and documentation (Schell-Chaple, 2017). The purpose of this study was to investigate the difference in CRRT therapy downtime with critical care nurse management compared to collaborative management performed by the critical care nurse and dialysis nurse.

Next, the literature will be reviewed.

Literature Review

Search Strategy

A comprehensive search of the literature was performed using OVID, PubMed and CINHAL. Information between the years 1990 – 2017 were collected using the key words, acute kidney injury, hemodialysis, continuous renal replacement therapy (CRRT), CRRT early initiation, CRRT downtime, CRRT nursing management and intensive care unit nurse driven protocols. Details regarding continuous renal replacement therapy including quality indicators, benefits of early initiation, and the effects of treatment interruption will be investigated. An examination of how nurse driven protocols can positively impact patient care and outcomes will be discussed. An inquiry into how to plan a successful CRRT nurse training program will be deliberated. An overview of hemodialysis will be discussed. A historical perspective of CRRT management will also be considered.

Acute Kidney Injury: Definition and Epidemiology

According to the Kidney Disease Improving Global Outcomes (KIDGO), acute kidney injury (AKI) is present if a patient develops one of the following criteria: an increase in serum creatinine level greater than or equal to 0.3 mg/dl within a 48-hour period**;** an increase in serum creatinine level greater than one and one-half times baseline; or urine output less than 0.5 ml/kg/h for 6 hours (Park et al., 2016). Acute kidney injury is common among patients in the intensive care unit (ICU) affecting up to 25% of patients and hospital mortality widely ranging from 28-90% (Nurmohamed, Koning, Vervloet, & Groenveld, 2011).

Uchino et al. (2005), conducted a large international study including 29,269 critically ill patients. Of those critically ill patients, 1,738 experienced AKI (6%) with 1,260 of those patients (73%) needing some type of dialysis. About 30% of patients affected with AKI had preadmission renal dysfunction (Uchino et al.). Independent risk factors that increase mortality with AKI include the use of vasopressors, mechanical ventilation, septic and/or cardiogenic shock and hepatorenal syndrome (Uchino et al., 2005). Recent studies show deaths of patients hospitalized and diagnosed with AKI are still high, with an average mortality of 60%. (Kee et al., 2015).

To survive AKI, rapid diagnosis and treatment are essential (Karvellas et al., 2015). One initial management of AKI can include diuretic management to increase urine output, but is often unsuccessful (Dirkes & Hodge, 2007). Intermittent hemodialysis can also be employed to remove waste from the blood and fluid from the body but often cannot be tolerated by patients that are hemodynamically unstable (Park et al., 2013). Continuous renal replacement therapy (CRRT) provides constant dialysis treatment over a 24-hour continuum and removes smaller amounts of fluid hourly and clears waste from the body (Roeder, Atkins, Ryan, & Harms, 2013).

Hemodialysis: Overview

One way to manage AKI is using intermittent hemodialysis to remove waste from the blood and fluid from the body (Park et al., 2013). Hemodialysis takes the blood from the body and externally filters the blood through a semipermeable membrane clearing waste products that are usually filtered by healthy kidneys and eliminated by the body though urination (“Hemodialysis,” n.d.). This type of dialysis is usually performed three times per week with treatments lasting three to four hours and removing two to three liters of fluid during that time (Park et al.). Many patients that are already hemodynamically tenuous are not able to tolerate the removal of such a large amount of fluid in a relatively short period of time. The Kidney Disease Improving Global Outcome (KDIGO) guidelines endorse hemodialysis for those who are hemodynamically stable ("KDIGO Clinical Practice Guidelines," 2012).

About 20 – 30% of ICU patients will experience hypotension while having intermittent hemodialysis (Villa, Ricci, & Ronco, 2015). Once a patient is in a critical state, other modes of dialysis need to be considered. The KDIGO Clinical Practice Guidelines for Acute Kidney Injury (2012), states the preferred method of dialysis for those hemodynamically unstable is CRRT.

Continuous Renal Replacement Therapy (CRRT)

By the 1980's, the search for a less invasive means to dialyze critically ill patients gave way to a dialysis pump accessed through a double lumen central venous catheter to provide a gentle and constant form of CRRT (Roeder, Atkins, Ryan, & Harms, 2013). Continuous renal replacement therapy was designed to emulate native kidney function by providing a constant dialysis treatment over a 24-hour day and has a filter life of 72 hours (Roeder et al.). Continuous renal replacement therapy is an extracorporeal method to remove blood from the body then passing it though a semipermeable, filtering waste products from the blood by diffusion (Roeder et al.).

Fluid removal is adjusted hourly by the nurse and accomplished via ultrafiltration (Schell-Chaple, 2017). Providers update the CRRT orders every 24 hours after considering factors like fluid overload and the need for fluid removal, electrolyte imbalances and incidences of the CRRT machine clotting (Schell-Chaple). An example of hourly fluid removal would be, “If the patient’s total intake is 100 mls for the hour and urine output is 10 mls, set the dialysis machine to remove an additional 90 mls”. This would allow the patient to have an even intake to output ratio. If the patient has fluid overload, the physician may write an order to remove additional fluid per hour. Any additional fluid removed that is more than a patient’s intake of hourly fluid is then recorded as a fluid loss. Hourly adjustment with CRRT allows for less fluctuation in fluid balance and is especially beneficial for patients who have hemodynamic instability (Schell-Chaple).

Continuous renal replacement therapy also requires the routine monitoring of electrolytes necessitating frequent blood draws to send to the lab, and repletion of electrolytes, usually according to a nurse driven protocol (Schell-Chaple, 2017). The most common complication of CRRT includes electrolyte imbalances, especially hypocalcemia and hypophosphatemia occurring in over 50% of the patients during treatment. When calcium levels are too low, it places the patient at a high risk for other complications such as hypotension, decreased cardiac output and potentially life threatening arrythmias. Low phosphorus levels can cause disturbances in metabolism and organ function. Potassium is cleared during CRRT and hypokalemia has a 28% occurrence. It is important not to over correct or under correct potassium levels during CRRT due to potassium’s narrow therapeutic index (Schell-Chaple).

CRRT: Research & Quality Indicators

Although CRRT is the recommended treatment for hemodynamically unstable AKI patients by the KDIGO Clinical Practice Guidelines for Acute Kidney Injury (2012), there continues to be a deficit in research evidence regarding best practice (Rewa et al., 2015). Potential quality indicator themes and measures such as; anticoagulation, CRRT dose prescription, treatment interruption, and issues related to venous access catheters and filter circuits need to be evaluated (Rewa et al.).

Anticoagulation. The B.E.S.T. Kidney (Beginning and Ending Supportive Therapy for the Kidney) study conducted a 15-month international survey from 54 centers in 23 countries and examined among other variables, the variation in CRRT practice (Uchino et al., 2007). Inconsistencies persist in the use of anticoagulation during CRRT to extend filter life by decreased clotting. Out of 997 patients enrolled in the B.E.S.T. study, only 3.3% of patients who received CRRT had bleeding, with almost 40% of those being bleeding at the indwelling vascular catheter site (Uchino et al.). Indications for anticoagulation are to extend filter life by reducing clotting. When using anticoagulation, there are variations as to what agent is best to be used. “The most common anticoagulant was unfractionated heparin, followed by sodium citrate, nafamostat mesylate and low molecular weight heparin” (Uchino et al., 2007, p. 1567).

A study published in 2015 by Ronco et al. discussed the risks and benefits of using anticoagulation during CRRT. Using anticoagulation during CRRT optimized the filter life by a reduction in filter clotting and ensuring circuit patency. Even though there are clear benefits for using unfractionated heparin, low molecular weight heparin and thrombin inhibitors, there is no clear recommendation which agent to use as best practice (Ronco et al., 2015). The Ronco et al. study outlines the risks to anticoagulation such as increased risk for bleeding especially when activated partial thromboplastin time exceeds 50 seconds. The development of heparin induced thrombocytopenia (HIT) is also a risk factor (Ronco et al.).

The use of citrate as an anticoagulation treatment was mentioned in Uchino et al. (2007) and Ronco et al. (2015) with similar recommendations. Both state that the use of citrate may increase CRRT filter life, has less risk of bleeding, and reduced need for blood transfusion. Citrate is hepatically cleared and may accumulate in the body causing metabolic acidosis and is not recommended for patients with liver disease (Morabito et al., 2014). The Kidney Disease: Improving Global Outcomes (KDIGO) guidelines recommend the use of citrate with CRRT if the patient has no contraindications. Still, the use of citrate as an anticoagulant remains underused with the increased cost of citrate being the probable factor (Ronco et al.).

Dose. Another barrier to defining best practice for CRRT management is actual dialysis therapy dose. Mortality and the CRRT therapy dosing were investigated and showed treatment with the optimal dose of 35 ml/kg/h resulted in better outcomes than treatment with a dose of 20 ml/kg/h (hospital mortality: 67.3% versus 60.8%, p=0.23) (Uchino et. al., 2007). The B.E.S.T. Kidney study found only 12% of patients were receiving the correct dose and almost half were treated below the 20 ml/kg/h dose, which is associated with a higher mortality rate (Uchino et al.).

Nurmohamed et al. (2011), conducted a retrospective single center study of 199 patients over a 1.5-year period. These patients had AKI secondary to acute sepsis requiring CRRT treatment. The 28-day mortality risk showed a median of 54% ($p<0.005$) with a CRRT delivered dose of less than 10 ml/kg/h. A CRRT delivered dose exceeding 30 ml/kg/h showed a decreased 28-day mortality risk of a median 12% vs. the lower dose ($p<0.005$). The conclusion suggests 20-30 ml/kg/h should be considered the recommended CRRT dosing. There may also be a survival benefit of about 23% when prescribing a 15% higher dose of 23 to 37 ml/kg/h (Nurmohamed et al.). The CRRT dose for patients with hypermetabolic states and sepsis is now recommended to be a minimum of 35 ml/kg/h (Ronco et al., 2015).

Management. There are variations in who provides the management of renal replacement therapy. Continuous renal replacement therapy may be delivered by the intensive care team, the nephrology/dialysis team or a combination of both (Rewa et al., 2015). In an effort to increase favorable patient outcomes, the Acute Dialysis Quality Initiative (ADQI) group (2016) attempted to identify quality indicators and standardize CRRT treatment (Schell-Chaple, 2017). The ADQI stresses the importance of implementing an adequate training program for the delivery and management of CRRT but does not specify the exact components of what an acceptable training program should include (Schell-Chaple). There also continues to be different nursing management of CRRT, with a trend for the critical care nurse to be autonomous with the set-up, management and troubleshooting of treatment instead of a collaboration between the critical care nurse and dialysis nurse (Schell-Chaple).

CRRT Research: Early Initiation

Patients undergoing coronary artery bypass grafting (CABG) have a high risk of AKI which is associated with an increased mortality rate of 28-64% (Sugahara & Suzuki, 2004). An earlier study conducted at Saitama Medical School Hospital compared the CRRT conventional start of treatment to an early start management (Sugahara & Suzuki). The conventional start group consisted of 14 patients that began CRRT when urine output was less than 20 ml/h for two hours in a row. Another 14 patients were included in the early start group and began CRRT once urine output was less than 30 ml/h for three consecutive hours (Sugahara & Suzuki). After being treated with CRRT, 12 out of 14 patients in the early group survived, compared to 2 out of 14 in the conventional start CRRT group (Sugahara & Suzuki). This study demonstrates early initiation of CRRT based on decreased urine output after cardiac surgery may improve survival of patients exhibiting AKI (Sugahara & Suzuki).

Seabra et al. (2008), identified and screened a total of 4,182 citations to select 23 studies for a meta-analysis investigating the correlation of reduced mortality and timing of initiation of CRRT. The 23 studies were comprised of four randomized control trials (RCTs), one quasi-RCT, one prospective comparative cohort study, 16 retrospective comparative cohort studies and one single arm study with a historic control group. Studies used either blood urea nitrogen (BUN) to determine early CRRT initiation (mean BUN levels ranging from 43-168 mg/dL) or late CRRT initiation (mean BUN levels ranging from 75-231 mg/dL) or serum creatinine of 3.6-4.3 mg/dL early CRRT initiation verses 6.1-8.1 in the CRRT late initiation groups (Seabra et al.). Primary analysis showed mortality in the CRRT late initiation was 66% and early CRRT was associated with 36%

reduction in mortality risk (Seabra et al.). The secondary analysis consisted of 2,108 patients from 18 comparative cohort studies. Overall mortality rate for late initiation of CRRT was 68%, compared to the early initiation of CRRT which was reduced by 28%. The study concluded there are definite benefits in survival when CRRT is initiated early (Seabra et al.).

Karvellas et al. (2011), conducted a systematic review and meta-analysis examining the 28-day mortality rate comparison between early and late initiation of renal replacement therapy. A comprehensive search identified a total of 1,494 citations. Two reviewers performed independent eligibility screening for the following criteria: observational cohort and/or randomized or quasi-randomized clinical trial design, population of critically ill adults >18 years old, diagnosis of acute kidney injury, descriptive factors regarding initiation of CRRT, and description of CRRT length of therapy with mortality and length of ICU and hospital stay. After the reviewers completed their screening, 15 studies and a total of 4115 patients were included in this meta-analysis. Although the definition of early versus late criteria was study specific, all studies had clear definitions listed in the studies. Out of the 15 studies, six defined early CRRT initiation based on serum urea, two based on serum creatinine, one study based on the Risk, Injury, Failure, Loss, End-stage (RIFLE) criteria, and four based on urine output. The other two studies used a combination of these factors to constitute CRRT early initiation (Karvellas et al.). Out of these 15 studies, two were RCTs, four were prospective cohort and nine were retrospective cohort (Karvellas et al.).

The total mortality rate for all 15 studies was 53.3% (1,431/2684). The findings suggest a significant improvement with the early initiation of renal replacement therapy compared to the late initiation group and an improvement in the 28-day mortality (OR 0.45, 95% CI 0.28-0.72, p<0.001). Out of the seven studies that reported on this data, five studies showed early initiation of CRRT had a positive impact on kidney recovery after discharge with patients less likely to need permanent dialysis treatment. A subgroup analysis showed no significant difference in a surgical versus mixed ICU and there was no significant difference between prospective versus retrospective studies (Karvellas et al., 2011).

Park et al. (2016), completed a multicenter prospective cohort study to examine the timing of initiating CRRT therapy and the outcomes it may have on elderly patients with acute kidney injury. A total of 607 patients that were age 65 or older and treated with CRRT were enrolled, with 303 in the early CRRT group and 304 in the late CRRT group. The early and late groups were divided based on hourly urine output with the early CRRT group having a median 6-hour urine output of (>/= 0.24 ml/kg/h) and the late CRRT group with a 6-hour median urine output of (<0.24 ml/kg/h). During the median follow-up of 9.6 days, there were 490 mortalities (79.2%). The 28-day cumulative survival rate was higher in the CRRT early start group with N=75 survivors in the CRRT early start group compared with N=41 in the CRRT late start group (p<0.01) (Park et al.).

Treatment interruption: CRRT Downtime. One goal of CRRT is to allow for uninterrupted treatment to achieve the full benefit of therapy. Interrupted CRRT can contribute to negative outcomes such as fluid overload, electrolyte imbalance acid-base imbalance and death (Rewa et al., 2015). The CRRT filter is designed to provide therapy for up to 72 hours before the filter and circuit need to be changed (Roeder et al., 2013).

One of the earliest studies done by Uchino et al. (2003) examined 48 patients receiving CRRT and found the median filter life was 15 hours and median CRRT downtime was three hours each day. A review of the charting for a total of 94 filters in nine patients showed clotting of the CRRT filter accounted for 77.6% of downtime (Uchino el al., 2003). Continuous renal replacement therapy downtime prevents patients from receiving full treatment and interventions to reduce downtime need further investigation (Roeder et al., 2013).

Other reasons for CRRT downtime can include patient going for off unit tests or procedures (Roeder et al., 2013). Venous access issues can also increase CRRT downtime. However, with proper catheter placement in the area of the right atrium and superior vena cava, downtime can be decreased by providing optimal blood flow. Nursing therapy management can minimize CRRT downtime by anticipating when there may be need for a filter and circuit change (Roeder et al.). This can be done by careful monitoring circuit pressures and examining the filter for clotting. Once the end of filter life is ascertained, the nurse can organize filter changing when interruptions are less likely to occur (Baldwin & Fealy, 2009).

A study by Kee et al. (2015) explored the impact of care given by physicians and nurses specially trained in CRRT and the impact it had on 28-day mortality rates. A total of 551 patients were divided into two groups according to the CRRT management team. The first group consisted of 298 patients cared for by a specialized CRRT team (SCT). The CRRT team consisted of two nephrologists, two nephrology fellows, an ICU specialist, three ICU residents and five nurses with specialized training in CRRT. The non-SCT group consisted of 253 patients who were cared for by a non-specialized ICU team of physicians and nurses (Kee et al.). When nurses received specialized CRRT management training, patient therapy downtime decreased from 5 hours to 3.8 hours per day (p<0.001). Also noted was a decrease in the 28-day all-cause mortality rate by 9% (p=0.046) (Kee et al.). This study reflects how a team specially trained in CRRT can improve mortality for patients on CRRT and specially trained nurses were able to significantly reduce CRRT downtime.

Nurse Driven Protocols

Nurse driven protocols provide an evidence-based, systematic approach to deliver nursing care ("Support Systems," 2012). Protocols are tools a nurse uses, along with critical thinking skills to administer a certain treatment, medication or care. Protocols are developed by expert individuals and are based in research and guided by best practice. They have long been used to improve patient outcomes by allowing nurses to use their clinical judgment guided by policy and procedures. Studies have shown that nurse driven protocols not only allow the nurse to provide high quality care, they also increase patient satisfaction and can provide cost effective delivery of medical care ("Support Systems").

A nurse driven pain management protocol for post cardiac surgery patients allowed nurses to administer pain medication based on a visual analogue scale (VAS) for the first 72 hours post-surgery (Van Valen, Van Vuuren, & Van Domburg, 2012). A total of 193 patients in the nurse driven pain management protocol were compared with 1535 patients in the control group. Patients in the nurse driven protocol group showed an 81% reduction in VAS score within three hours with no adverse side-effects or re-admission to the ICU. This study suggests that VAS scores in cardiac surgery patients can be significantly reduced with a nurse driven pain management protocol is utilized (Van Valen et al., 2012).

When a nurse driven protocol was implemented at a hospital with low respiratory therapist staffing to improve mechanical ventilator weaning, positive outcomes were appreciated (Danckers et al., 2012). The length of mechanical ventilation days of 102 patients being managed by a nurse driven weaning protocol were compared with the number of ventilator days experienced by a retrospective sample of 100 patients with a physician directed protocol. When comparing the nurse-driven mechanical ventilation weaning protocol to the physician directed approach, the following improvements in patient outcomes were evident. Duration of ventilation was two days with nurse driven protocol and four days with physician driven protocol ($p=0.001$). Length of ICU stay was decreased by two days ($p=0.01$) with the nurse driven protocol and time of extubation was 2 hours 13 minutes less in the nurse driven protocol group ($p<0.01$). There was no difference in ventilator associated pneumonia (VAP), or re-intubation with the nurse driven protocol group (Danckers et al.). After this study was completed, the intensive care physicians were surveyed on a 5-point Likert Scale, with a score of 1 being most favorable and a score of 5 being least favorable, to determine their attitudes towards this nurse-driven protocol. The survey showed physicians' mean scores of 1.59-1.87 on a 5-point Likert Scale which suggests a positive acceptance of this protocol into practice (Danckers et al.).

Catheter associated urinary tract infections (CAUTIs) are responsible for 40% of all hospital acquired infections (Mori, 2014). A quality improvement project at a 150-bed community hospital allowed nurses to remove foley catheters without a physician's order based on a "foley catheter survey tool" designed by the hospital's clinical nurse specialist. There were three CAUTIs out of 389 patients in the pre-intervention group, compared with only one CAUTI out of 282 patients in the post-intervention group. Post-intervention CAUTIs were decreased from 0.77% to 0.35%. Catheter usage also declined from 37.6% to 27.7% after the implementation of this nurse driven protocol (Mori, 2014).

The above research studies are just a few of the many examples illustrating nurse driven protocols having a positive impact on patient outcomes. Allowing nurses to apply judgement along with evidence-based practice can be utilized to provide high quality, cost effective care. This concept may be applied to several aspects of nursing practice including a nursing management protocol to maximize the effectiveness and benefit of CRRT.

CRRT Nurse Training

Background. The Acute Dialysis Quality Initiative (ADQI) is a consensus group that brought forth clinical practice recommendations in 2016 to improve outcomes for patients being treated with CRRT (Schell-Chaple, 2017). The ADQI's objectives are to standardize the process of dialysis in the ICU, bring forth recommendations for best practice, use evidence-based practice to develop guidelines, and bring forth ideas for future research. The ADQI emphasizes the importance of having specially trained nurses to provide CRRT and adequately monitor patients' response to therapy and troubleshoot potential complications (Schell-Chaple).

There are no universal training competencies for CRRT. Most hospitals design their own training program and are developed by nurse managers and educators (Golestaneh et al., 2012). The American Nephrology Nurses Association is a valuable resource for information. Manufacturers of the dialysis machines have representatives that can also assist with education (Golestaneh et al., 2012). There have been some articles guiding what constitutes a successful CRRT training program (Schell-Chaple, 2017). Even though CRRT is commonly used to treat AKI in the ICU setting, some smaller hospitals have limited exposure to CRRT making it difficult to maintain skills. In this case, it may be beneficial to incorporate simulation into the education plan (Schell-Chaple).

Some institutions share the critical care nurses' management of CRRT with the dialysis nurse. Often the dialysis nurse is responsible for priming the dialysis machine, connecting the patient to the machine to receive therapy and for advanced troubleshooting (Baldwin & Fealy, 2009). This method of shared responsibility can be problematic if there is not a dialysis nurse onsite 24/7. Frequent clotting of the filter is a common barrier to providing continuous therapy (Uchino et al., 2003). If the institution does not have a dialysis services at night, on the weekends, or on holidays, to prime the machine, the patient can experience an extended interruption in treatment (Baldwin & Fealy). Implementing an extensive CRRT educational program to critical care nurses allows for autonomy in managing treatment and offers high quality, cost effective care.

Research. Utilizing a specialized CRRT trained team appears to have a positive impact on downtime, the number of filters used, ICU length of stay and patient mortality (Kee et al., 2015). A study at Yonsei University Health System employed a team comprised of physicians and nurses that received specialized training in CRRT (Kee et al.). This team was responsible for devising their own CRRT educational program and management protocol. A total of five CRRT nurses were responsible for the sole management of a 112-bed surgical and medical ICU. These specially trained CRRT nurses participated in monthly quality control meetings to discuss issues and make protocol improvements. In addition, they also provided CRRT basic management education to bedside nurses every quarter (Kee et al.).

Kee et al. (2015) enlisted a total of 551 ICU patients having AKI and requiring CRRT. The ICU patients were divided into two groups. One group was cared for by specialized CRRT team (SCT) comprised of nurses and physicians with specialized training in CRRT management (n=298) the other group was cared for by non-SCT management (N=253). The results showed the following benefits: Less down time in the group managed by the SCT compared to non-SCT management (3.2 hours SCT per day vs. 5.1 non-SCT); less total CRRT therapy time (4 days SCT vs. 7 days non-SCT); decreased length of ICU stay (18 days SCT vs. 21 days non-SCT); and overall mortality decrease of 14.2% when patients were managed by SCT (Kee et al.).

Program Design

The Acute Dialysis Quality Initiative consensus group recommends specialized training for nurses managing CRRT; however, there is a deficit in outlining exactly what this CRRT training should contain (Schell-Chaple, 2017). As new research regarding the management of CRRT evolves, an annual review of the training program should be completed to allow for updated content to be integrated (Przybyl, Evans, Haley, Bisek, & Beck, 2017). Initial CRRT training usually involves an overview of the physiology behind dialysis, set up of the dialysis machine and circuit, identifying alarms and how to troubleshoot, as well as connection and disconnection of the machine to the patient. This involves classroom and bedside training. The amount of training time varies per institution and can be tailored to the volume of CRRT a particular unit may encounter (Przybyl et al., 2017). Classes ideally are offered a minimum of twice per year allowing for new nurses to learn the skill and offering experienced nurses an opportunity for review. These classes can be taught by the nurse educator, the manufacturer's representative, dialysis nurse or designated "super users" which are staff nurses that have received advanced training and are a great resource for the entire staff (Przybyl et al.).

Once a CRRT training program has been established, assessing and maintaining skills through annual competencies are required (Przybyl et al., 2017). Competencies can be administered as an e-learning module and can be combined with bedside skill demonstrations. The utilization of CRRT simulation training is particularly helpful with organization having low-volume CRRT programs. Intermediate and advanced CRRT training programs can also be offered. Intermediate programs are designed to reinforce previous concepts and investigate different modes of therapy and explore advanced troubleshooting. Strategies in anticoagulation therapy should be taught and the latest information regarding evidence-based practice is presented (Przybyl et al.).

Advanced CRRT training is designed for nurses to become super users. Classes usually include etiology of AKI, pathophysiology of the renal system and advanced electrolyte, fluid status and acid base management (Przybyl et al., 2017). Skills in CRRT teaching and precepting are also included as these nurses will now be considered experts in CRRT management and capable of instructor status (Przybyl et al.).

Next, theoretical framework will be presented.

Theoretical Framework

It is important to incorporate a theoretical framework into a CRRT educational plan. Benner's Novice to Expert Model best represents the trajectory for nurses attaining the clinical competence to master total management of CRRT. Patricia Benner explains there are five levels of proficiency when acquiring a new skill and developing proficiency: novice, advanced beginner, competent, proficient, and expert (Benner, 1982).

Level I: Novice

The novice is new to the role in which they are to partake. They have no previous experience or knowledge regarding the task at hand (Benner, 1982). When teaching the novice a new skill, these skills are introduced to them as objective attributes that can be identified even when there is no clinical experience (Benner). One barrier the novice faces is lack of clinical judgement. When applying newly learned information, one applies those abilities according to the textbook situation. However, real-life situations can complicate how to apply a newly learned skill. This level applies to the nurse that is first introduced to CRRT. The educational requirements at this level will involve basic set-up of the machine, CRRT charting, introduction to order sets and protocols and basic troubleshooting (Przybyl et al., 2017). The novice level of functioning is very "task-oriented". The novice benefits greatly from having resources available, such as a preceptor, checklists and reference books (Przybyl et al.).

Level II: Advanced Beginner

The advanced beginner can perform the learned skill and has enough experience to identify recurrent clinical patterns (Benner, 1982). Benner identifies these "recurrent meaningful situational components as aspects" (p. 403). For the nurse to identify aspects, there must be enough clinical experience with the learned skill to understand patterns of occurrence (Benner). For the nurse learning CRRT, they may be able to identify that a patient's neck position may kink the venous catheter and cause a high-pressure alarm. More advanced troubleshooting cannot be achieved at this level because the advanced beginner is still trying to become competent with the basic skills learned as a novice (Benner). As more and more aspects of CRRT are identified, the advanced beginner begins to build their critical thinking skills (Przybyl et al., 2017). At this stage, preceptorship continues to be extremely important. As experience is gained, it may not be necessary to have a preceptor constantly with the advanced beginner but having a mentor will be extremely helpful (Benner).

The intermediate CRRT education classes are designed to reinforce the skills they have learned as beginners and develop more advanced skills that will lead them to the next level of developmental proficiency (Przybyl et al., 2017).

Level III: Competent

The level of competent is achieved after having a few years of experience and can visualize long term goals of care (Benner, 1982). This experience allows the nurse to know which attributes and aspects of care are most important and build priorities of care based on this knowledge (Benner). Nurses at this level usually have a level of satisfaction in their abilities. They still dissect care in small chunks and sometimes neglect to see the situation as a whole (Benner). Being competent at a skill is usually perceived as an institutionally satisfactory performance, and many nurses will stay at this level for their career (Benner).

When making the transformation from critical care nurse and dialysis nurse collaborative CRRT management to total critical care nurse management, many experienced nurses are already functioning at the competent level (or beyond). It is important to note, learning dialysis machine set-up, patient connection for therapy and advanced trouble-shooting will bring the experienced nurse back to the novice level to learn this new skill. Prior experience with CRRT charting and protocols will allow for the nurse to advance back to the competent level in a much shorter period. Once these nurses are back to the competent level, they are then able to assist others in learning independent CRRT management. The competent nurse can handle many situations that may arise with CRRT management.

Level IV: Proficient

The proficient nurse can see situations "as a whole", allowing for perception and perspective (Benner, 1982). They no longer see the situation as separate parts. They become familiar with what is the "norm" but more importantly can identify when things are not normal (Benner). Perception now allows for a higher level of decision making and the proficient nurse understands the concept of what is normal, may be totally different from one patient to the next (Benner).

Most education is geared toward the novice to competent path, allowing for less educational opportunity for the proficient nurse (Benner, 1982). Educational programs for the proficient nurse are best designed by using case studies and examples that are unique, requiring advanced critical thinking skills to apply (Benner). When nurses achieve proficient status with CRRT management, they are the ideal resource to be considered “super users” (Przybyl et al., 2017).

Level V: Expert

The expert nurse functions at the highest level of understanding without needing to reference guidelines or maxims (Benner, 1982). These are the nurses that lend themselves to write new guidelines and protocols based on research and experience (Przybyl et al., 2017). They have a deep understanding that at times cannot be explained and often will do things based on intuition (Benner). The nurse that is an expert in CRRT will be the resource to design and update the institution’s CRRT educational plan (Przybyl et al.). These are the nurses who discover phenomena contributing to advanced research.

Next, methods and procedures will be presented.

Method

Purpose

The purpose of this study was to investigate the difference in CRRT therapy downtime with critical care nurse management compared to collaborative management performed by the critical care nurse and dialysis nurse.

Design

A retrospective chart review consisting of two groups was used compare CRRT downtime in: (1) patients receiving CRRT with critical care nurse total management; and (2) patients receiving CRRT with collaborative management by the critical care nurse and dialysis nurse. Downtime was defined as any time a patient is not receiving CRRT therapy. Any incidence of CRRT downtime due to a medical order such as going off unit for a procedure or and for CRRT to be discontinued was excluded.

Study Site

This study was performed at the University of Massachusetts Medical Center (UMMC), University Campus. The University of Massachusetts Medical Center is a 781-licensed bed facility dispersed on three campuses that are located in Worcester, MA. The University Campus is a 417-bed Level I Trauma Center located at 55 Lake Ave North. The data were collected from two ICUs at UMMC. The first unit was 3 Lakeside ICU (3LS ICU), which is a 16-bed intensive care unit providing care to cardiac medical and post-op cardiac surgical patients. This ICU's CRRT patients were managed by the critical care nurses, including set-up of the dialysis machine, initiating therapy, managing hourly fluid removal, monitoring and repletion of electrolytes and advanced troubleshooting. The second unit was 6ICU, which is a 16-bed medical ICU. The CRRT patients were managed collaboratively by the critical care nurses and the dialysis nurses. The critical care nurses were responsible for managing hourly fluid removal, monitoring and repletion of electrolytes, and simple troubleshooting. The dialysis nurse was responsible for set-up of the dialysis machine, initiating therapy and may be called upon for advanced trouble shooting.

Sample Population

A retrospective chart review of patients who received CRRT was conducted. Inclusion criteria were charts of patients who received CRRT in 3 Lakeside ICU and 6 ICU between October 1st, 2017 and October 1st, 2018. Any incarcerated individuals (prisoners) were excluded from this study. Individuals who were not yet adults (<18 years of age), were excluded from this study. Patients who expired within 24-hours of initially starting CRRT were also excluded. Any incidences of CRRT downtime due to a medical order such as going off unit for a procedure or an order for CRRT to be discontinued were excluded. Patient variables such as age, co-morbidities and gender were not included as they do not impact on length of downtime.

A total of 100 charts per unit were requested to review with a goal of 30 charts per ICU minimum. A power analysis was performed for t-test, independent sample group, two tailed, effect size 0.5, level of significance 0.05 and power 0.8 to calculate sample size of downtime to be collected. After power analysis, a minimum of 64 downtime incidences per unit was the goal.

Procedures

An appointment was made with UMass Chief Nursing Officer to discuss the details of this study. Upon her endorsement, submission to the University of

Massachusetts Medical Center Institutional Review Board (IRB) for study approval was performed and achieved. Rhode Island College's IRB was consulted and deferred to allow the University of Massachusetts Medical Center to serve as the IRB of record. A retrospective chart review of the patients' electronic medical records was performed. Data between the times of October 1st, 2017 – October 1st, 2018, were collected from charts. This data collection was performed with the assistance of the IT – Data Sciences & Technology Department located at the University of Massachusetts Medical School, Worcester, MA. Patients' medical record numbers and International Classification of Diseases (ICD) codes were used to identify which patients had AKI. Out of the patients with AKI, it was then identified what patients received CRRT as part of their treatment. The downtime of CRRT was then identified. Any downtime incidence that correlated with an order to hold CRRT treatment for any reason was excluded from the data. Each patient and his/her downtime incidences were assigned a random ID number from 0 – 79 and the medical record number was removed to ensure patient confidentiality.

Measurement

The data collected were the actual length of CRRT downtime each patient experienced and were recorded in seconds of downtime of each ICU on the data collection tool (Appendix A & Appendix B). All information was de-identified and stored at the University of Massachusetts Medical School by the IT – Data Sciences & Technology Department. If there was an indication such as leaving the unit for a test, or an order for CRRT to be postponed for a period, that downtime data was excluded as it did not reflect nursing management's effect on downtime. Each downtime occurrence was recorded as “Time Difference in Seconds." A patient may have had several downtimes during the course of CRRT therapy.

Data Analysis

A two tailed t-test of unequal variances was performed, and the mean difference in CRRT downtime was calculated. Level of significance was set at >0.05. This information was obtained and reported as aggregate information in the results section of this study.

Next, study results will be presented.

Results

A total of 17 patients in 3 Lakeside ICU and 23 patients in 6 ICU were identified as having AKI and receiving CRRT. Patients who expired within 24-hours of initially starting CRRT were excluded. Any incidence of CRRT downtime due to a medical order of discontinuation was excluded. The 17 patients in 3 Lakeside ICU generated a total of 43 downtime incidences and the 23 patients in 6ICU generated a total of 48 downtime incidences. The point of downtime was determined by when CRRT was documented as "initiated" after being recorded as "off" on the electronic medical chart CRRT dialysis flow sheet. These individual downtimes were documented and recorded in seconds of downtime on the data collection tool (Downtime Data Collection Tool 3 Lakeside ICU - Appendix A & Downtime Data Collection Tool 6 ICU - Appendix B). Table 1 illustrates the statistical summary for both ICUs. Both data collection tools show a random de-identified patient ID as well as a random flow chart ID number. Each patient may have had more than one downtime incidence recorded on the collection tool.

Table 1. Statistical summary for 3 Lakeside ICU and 6ICU CRRT Downtime.

SUMMARY STATISTICS	Column1	Column2
	3 Lakeside ICU	6 ICU
N	43	48
Mean	7728.8	13915
Std Dev.	8864.4	13177.4
Median	3600	7950
Mode	3600	3600
Min	900	720
Max	40680	50100
IQR	4110	18000

The mean CRRT downtime incidence was 7,728.8 seconds in 3 Lakeside ICU with a high range of 40,680 seconds to a low of 900 seconds with a standard deviation of 8864.4. The mean CRRT downtime in 6ICU was 13,915 seconds of CRRT downtime in 6ICU with a high range of 50,100 seconds and a low of 720 seconds and a standard deviation of 13177.4. Figure 1 illustrates the mean difference in CRRT downtime recorded in seconds between 3 Lakeside ICU and 6 ICU.

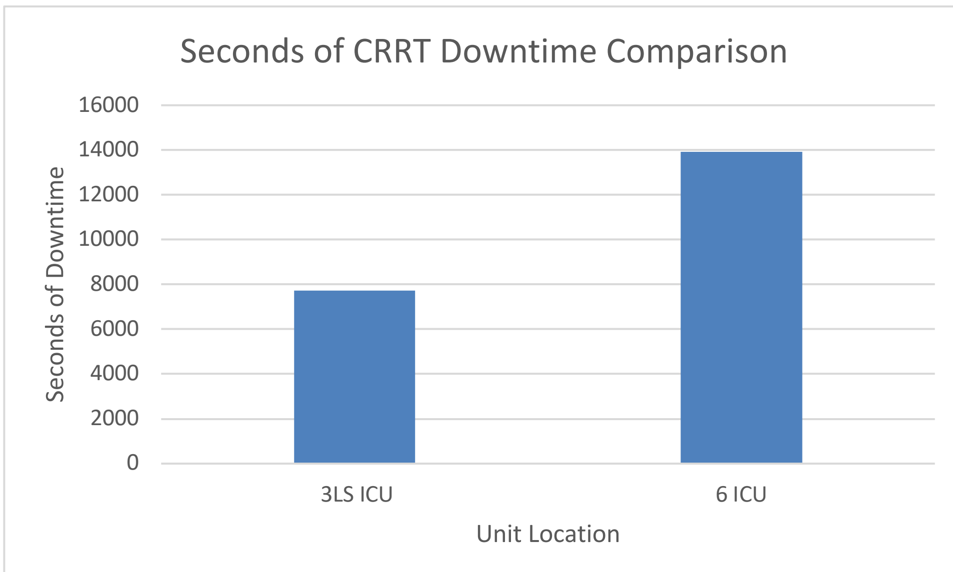

Figure 1. Difference in CRRT downtime between 3 Lakeside ICU and 6ICU.

A two tailed t-test of unequal variances was conducted to compare the seconds of CRRT downtime in 3 Lakeside ICU and 6ICU. There was a significant difference in CRRT downtime (n=43) between 3 Lakeside ICU (m=7728.8, SD=8864.4) and CRRT downtime (n=48) in 6 ICU (m=13915, SD=13177.4); $p = .01$.

Next, summary and conclusion.

Summary and Conclusions

Acute kidney injury (AKI) is common among patients in the intensive care unit (ICU) and can have a mortality rate of up to 70% (James & Tonelli, 2011). According to the KDIGO Clinical Practice Guidelines for Acute Kidney Injury (2012), CRRT is the recommended treatment for hemodynamically unstable AKI patients. Continuous renal replacement therapy provides constant dialysis treatment over a 24-hour day and removes small amounts of fluid hourly and clears waste from the body (Roeder, Atkins, Ryan & Harms, 2013). Interrupted CRRT can contribute to negative outcomes such as fluid overload, electrolyte imbalance, acid-base imbalance and death (Rewa et al., 2015).

There continues to be variations in who provides the nursing management of CRRT. Some institutions employ a collaborative model of CRRT management between the critical care nurse and the dialysis nurse. Often the dialysis nurse is responsible for priming the dialysis machine, connecting the patient to the machine to receive therapy and for advanced trouble-shooting (Baldwin & Fealy, 2009). This method of shared responsibility can be problematic if the dialysis nurse is not readily available and can result in delay of treatment. In an effort to reduce CRRT downtime, there has been a trend for the critical care nurse to be autonomous with the set-up, management and trouble-shooting of treatment instead of a collaboration between the critical care nurse and dialysis nurse (Schell-Chaple, 2017).

The Acute Dialysis Quality Initiative (ADQI) is a consensus group that brought forth clinical practice recommendations in 2016 to improve outcomes for patients being treated with CRRT (Schell-Chaple, 2017). The ADQI's objectives are to standardize the process of dialysis in the ICU, bring forth recommendations for best practice, use evidence-based practice to develop guidelines and bring forth ideas for future research (Acute Dialysis Quality Initiative (ADQI), 2013). The ADQI emphasizes the importance of having specially trained nurses to provide CRRT and adequately monitor patients' response to therapy and troubleshoot potential complications (Schell-Chaple). One goal of CRRT is to allow for uninterrupted treatment to achieve the full benefit of therapy. Minimal research has looked at nursing management of CRRT and the impact it has on timely initiation of therapy, minimizing interruption of treatment, patient outcomes and the provision of cost-effective care (Golestaneh, Richter, & Amato-Hayes, 2012).

The purpose of this study was to investigate the difference in CRRT therapy downtime with critical care nurse management compared to collaborative management performed by the critical care nurse and dialysis nurse. It was proposed that a patient would have less CRRT downtime with the critical care nurse having autonomous management of therapy. The study was guided by Benner's Novice to Expert Model as it best represents the trajectory for nurses attaining clinical competence from novice to expert level. A retrospective chart review was conducted; a total of 17 patients in 3 Lakeside ICU and 23 patients in 6 ICU were identified as having acute renal failure and receiving CRRT. The 17 patients in 3 Lakeside ICU generated a total of 43 downtime incidences and the 23 patients in 6ICU generated a total of 48 downtime incidences. The data showed the mean CRRT downtime incidence was 7,728.8 seconds in 3 Lakeside ICU, compared to 13,915 seconds of CRRT downtime in 6ICU. On average, patients had a 1.72-hour quicker CRRT re-start time in 3 Lakeside ICU when compared to the re-start time in 6 ICU. These results suggest that a patient will experience significantly less downtime when CRRT management is done by the critical care nurse independently compared to a collaborative management by the critical care nurse and dialysis nurse. This may potentially equate to several more hours of CRRT treatment considering a patient may have one or more re-start times in a 24-hour period.

The outcome of this study suggests that critical care nurse management of CRRT has significantly less patient therapy downtime than a collaborative management shared by the critical care nurse and dialysis nurse. This was revealed by performing a t-test on the mean of the data and obtaining a level of significance of $p>0.05$. Showing a significance in reducing CRRT downtime based on nursing management can impact CRRT guidelines and influence evidence-based practice.

The study was limited by the institution's transitioning to a new electronic medical record (EMR) system. To keep the data consistent, only downtime recorded on the new medical record documentation system was used, which decreased the desired sample size of 64 downtime incidences per unit. Previous to the employment of a new EMR documentation system, CRRT data was recorded on an hourly paper flow sheet. Some inconsistency can be expected with a new way of documentation. There was also no way of telling if the dialysis nurse had planned a routine filter change and was already present on 6 ICU. This would affect the data of 6 ICU by decreasing the overall mean downtime.

In conclusion, patients in 3 Lakeside ICU with critical care nurses having autonomous management of CRRT had significantly less therapy downtime than patients receiving CRRT in 6 ICU which employs a combined management between the critical care nurse and the dialysis nurse ($p=0.01$). Allowing the critical care nurse to have total management of CRRT resulted in a patient experiencing significantly less therapy downtime than when the CRRT management is shared between the dialysis nurse and critical care nurse. This can have a positive effect on patient outcome and should be considered best practice.

Next, recommendations and implications for advanced nursing practice.

Recommendations and Implications for Advanced Nursing Practice

This retrospective chart review yielded valuable information regarding best nursing practice for CRRT management. There is little research that investigates the correlation of nursing management of this treatment and its benefit for providing consistent and minimally interrupted dialysis therapy. This research provides valuable evidence that patients receiving CRRT delivered by critical care nurses will experience less therapy downtime when compared to a combined management between the critical care nurse and the dialysis nurse. With critical care nurse CRRT management, the reduction of therapy downtime was statistically significant and thus supporting this model of care is evidence based best nursing practice.

The Advanced Practice Registered Nurse (APRN) as a member and leader of the interdisciplinary team can impact policy development. Because of the APRNs' unique training in nursing theory and practice, they can best advocate for change in nursing policies. This research suggests that nursing management of CRRT management can positively influence patient outcomes. The APRN has the ability to present research information to hospital administration and help develop new policies and procedures.

As a positive role model, the APRN can work with the bedside nurse to educate them about the impact of evidence-based research and implement change in practice. As implicated in this study's literature review, the CRRT training for nurses have no clear guidelines. This is an area for the APRN to act as a change agent for nursing practice. APRNs can seek the support of their professional organizations, to help standardize education and practice for nursing delivery or CRRT. APRNs also have the opportunity to seek grants and conduct research to further support evidence-based care.

Continuous renal replacement therapy and nursing management has been grossly understudied. Further research and practice development are needed to continue to support or dispute that autonomous CRRT management by the critical care nurse reduces downtime and thus improves patient outcomes. As recommended in 2016 by the Acute Dialysis Quality Initiative Group, there is a need to identify quality indicators and standardize CRRT treatment. The APRN can be key to implementing this by conducting further research to influence the standardization of nursing practice of CRRT management. The APRN can also be a key participant in a hospital-based CRRT management nursing education initiative and help develop a standardized program that can be presented through professional associations and facilitate a nation-wide education system.

APRNs can enable nursing policy and procedure development at a state and federal level. By staying current with the latest evidence-based practice, operating as a change agent at the local level, and further developing best practice through conduction of nursing research, the APRN has the unique opportunity to represent the profession of nursing as an integral and influential part of the medical team.

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Appendix A

Downtime Data Collection Tool 3 Lakeside ICU

GENERIC_PATID	GENERIC_FLWSHT_ID	DEPARTMENT	TIME_DIFFERENCE_SECONDS
21	23	UNV 3 LAKESIDE ICU	3600
21	25	UNV 3 LAKESIDE ICU	3600
20	54	UNV 3 LAKESIDE ICU	3600
20	54	UNV 3 LAKESIDE ICU	10200
20	55	UNV 3 LAKESIDE ICU	7200
20	58	UNV 3 LAKESIDE ICU	3600
20	59	UNV 3 LAKESIDE ICU	3600
20	60	UNV 3 LAKESIDE ICU	1800
20	60	UNV 3 LAKESIDE ICU	7200
20	60	UNV 3 LAKESIDE ICU	40680
17	71	UNV 3 LAKESIDE ICU	4200
17	73	UNV 3 LAKESIDE ICU	2760
63	80	UNV 3 LAKESIDE ICU	7200
33	127	UNV 3 LAKESIDE ICU	900
33	130	UNV 3 LAKESIDE ICU	2580
33	131	UNV 3 LAKESIDE ICU	7200
33	133	UNV 3 LAKESIDE ICU	3600
47	134	UNV 3 LAKESIDE ICU	1800
47	137	UNV 3 LAKESIDE ICU	2460
47	137	UNV 3 LAKESIDE ICU	3600
48	141	UNV 3 LAKESIDE ICU	26400
47	142	UNV 3 LAKESIDE ICU	5100
47	145	UNV 3 LAKESIDE ICU	2100
48	148	UNV 3 LAKESIDE ICU	2400
44	161	UNV 3 LAKESIDE ICU	16800
44	169	UNV 3 LAKESIDE ICU	19620
8	212	UNV 3 LAKESIDE ICU	3600
8	217	UNV 3 LAKESIDE ICU	7140
8	218	UNV 3 LAKESIDE ICU	3600
32	223	UNV 3 LAKESIDE ICU	1440
32	225	UNV 3 LAKESIDE ICU	6300
51	239	UNV 3 LAKESIDE ICU	9000
0	240	UNV 3 LAKESIDE ICU	2940
51	241	UNV 3 LAKESIDE ICU	4500
1	248	UNV 3 LAKESIDE ICU	1560
1	248	UNV 3 LAKESIDE ICU	3600
1	248	UNV 3 LAKESIDE ICU	12600
38	280	UNV 3 LAKESIDE ICU	14400
38	281	UNV 3 LAKESIDE ICU	34680
9	293	UNV 3 LAKESIDE ICU	3240
9	301	UNV 3 LAKESIDE ICU	22740
68	316	UNV 3 LAKESIDE ICU	3600
35	329	UNV 3 LAKESIDE ICU	3600

Appendix B

Downtime Data Collection Tool 6 ICU

GENERIC_PATID	GENERIC_FLWSHT_ID	DEPARTMENT	TIME_DIFFERENCE_SECONDS
71	1	UNV 6 ICU	5220
71	2	UNV 6 ICU	34680
71	5	UNV 6 ICU	12600
71	7	UNV 6 ICU	7200
31	20	UNV 6 ICU	30600
26	44	UNV 6 ICU	17640
62	69	UNV 6 ICU	23400
62	70	UNV 6 ICU	18000
3	81	UNV 6 ICU	4200
3	82	UNV 6 ICU	41400
69	84	UNV 6 ICU	3600
69	84	UNV 6 ICU	18000
69	86	UNV 6 ICU	3000
3	88	UNV 6 ICU	2700
25	91	UNV 6 ICU	8700
25	94	UNV 6 ICU	25200
25	94	UNV 6 ICU	2880
25	98	UNV 6 ICU	11700
25	101	UNV 6 ICU	50100
25	108	UNV 6 ICU	44280
34	128	UNV 6 ICU	32340
70	180	UNV 6 ICU	2640
70	182	UNV 6 ICU	4500
70	184	UNV 6 ICU	1380
6	186	UNV 6 ICU	5220
57	189	UNV 6 ICU	24540
57	190	UNV 6 ICU	15840
57	194	UNV 6 ICU	21000
27	198	UNV 6 ICU	3600
19	208	UNV 6 ICU	14280
42	227	UNV 6 ICU	32400
53	254	UNV 6 ICU	18000
53	257	UNV 6 ICU	3600
12	264	UNV 6 ICU	3540
52	270	UNV 6 ICU	3600
52	270	UNV 6 ICU	1980
2	272	UNV 6 ICU	10800
66	274	UNV 6 ICU	4800
52	275	UNV 6 ICU	2700
52	282	UNV 6 ICU	720
22	288	UNV 6 ICU	3600
55	306	UNV 6 ICU	780
55	306	UNV 6 ICU	4500
55	308	UNV 6 ICU	29580
16	310	UNV 6 ICU	10200
39	319	UNV 6 ICU	6960
39	321	UNV 6 ICU	4740
39	321	UNV 6 ICU	34980